Your final project is to be submitted **individually**. However, each project may have **up to two named advisors** (these are students in the course). A minimum of one advisor per project is recommended. These advisors are to give you tips and feedback on your project dealing with the mathematical content, the software, the presentation, and the use of the English language. It is recommended that in addition to working on your project, you serve as an advisor to one or two other projects (you may advise a maximum of three projects). If you are strong in A and need help wtih B, seek advisors in B and offer your advise with A.

Plagiarism will not be tolerated. There is a clear difference between receiving advise and copying the work of others. The voice recording submitted with the project will describe the advise received and name the advisors. Advisors can be great at catching mistakes in mathematics, coding style, or English.

Your project submission should have demonstrations for 3 out of these 6 topics appearing in [DSUC] (see the course website):

- Topic 2 (perceptron).

- Topic 4 (classification).

- Topic 5 (multi-objective and regularization).

- Topic 9 (Gaussians weighted least squares).

- Topic 11 (gradient descent).

- Topic 12 (PCA).

Choose any three topics of your liking. For each topic, create illustrative demonstrations of the topic, making references to concepts from linear algebra as they arise. See below a list of "questions" that need to be answered with your demonstrations.

For each topic you should carry out the following:

1. Create a formatted one page summary of the content, highlighting the main methods, tools, results and applications. This needs to be a brief and sharp write-up accessible to other students in the course that haven't studied the specific topic. A good summary will possess qualities similar to (part-of) a good Wiki summary. It is to be handed in as a single A4 PDF page. Including formulas and images is encouraged.

2. Create a Julia Jupyter notebook with one to three code demonstrations of the results and methods of the topic. Code snippets similar to those of the [SWJ] book are encouraged. The Jupyter notebook should also have some mark-down formatted cells with equations where appropriate. This notebook should be a demonstration of the concepts learned.

For **only one** of the three topics, carry out the following:

3 Create a YouTube video, no longer than 8 minutes, demonstrating the Jupyter notebook and the code it contains. Code snippets may be executed with several different parameters in a way that demonstrates the results and methods. If you prefer to use another video sharing platform other than YouTube, that is fine as long as the video is easily accessible to the teaching staff (do not send video files via e-mail).

In your hand-in make sure that each document that you created has your name on it. Your hand-in should be in a single e-mail sent to the course e-mail address. There should be 10 files attached to the e-mail (compressed into a single folder) and a link to a video. The content of the hand-in e-mail should also specify which topics you chose to work on. The files/link attached to the the e-mail should be exactly:

- Three PDF summaries for (1) above.

- Three .ipynb Jupyter notebook files for (2) above.

- Three PDF printouts of the Jupyter notebooks.

- A viewable link to the single video that you created (YouTube or other means). (3) above.

- The typical voice recording summarizing your experience with the project, naming the advisors, and confirming you worked on the project honestly.

Projects will be marked based on the following criteria:

1. 5% - for following instructions. You either get this mark, or loose 5% if you deviated from the hand-in instructions.

2. 15% - visual presentation. You get 15% if the notebooks and PDF files appear clean, visually pleasant, graphs are labelled, images are not pixelated, text and Julia code is properly formatted and appears cleanly.

3. 20% - for the video. You get 20% if the video is fully precise and can be useful for others. You get 5% if the video is of very poor quality. You get something in the middle depending on the quality of the video. It is clear that English is not the first language of many speakers. Points will NOT be deducted for pronunciation, accent, or minor deviations from standard English. Note that the video does not require any additional content or animations beyond the Jupyter notebook. Still, you can add splash animations or anything else if you see fit.

4. For each of the three topics, 10% for the PDF summary (full marks for a crisp and precise summary that answers the "questions" without flaws), and 10% for the Jupyter notebook (full marks if the choice of content is sensible and the code examples work, make sense, and answer the "questions" sensibly.).

So what are the "questions"? Most of the "questions" are very straight-forward and only deal with demonstrating the topics at hand:

- Topic 2 (perceptron):
  Q: How does the perceptron work?
  Q: What is the convergence theorem for the perceptron? That is, how do you prove the theorem?

- Topic 4 (classification).
  Q: How does least-squares classification work?

- Topic 5 (multi-objective and regularization).
  Q: What is the general problem of multi-objective regularization?
  Q: What is ridge-regression and how is it a special-case?
  Q: What are some ways to choose the regularization parameter for ridge regression?

- Topic 9 (Gaussians).
  Q: What is the multi-variate Gaussian distribution?
  Q: How is the bivariate distribution a special case?
  Q: How to carry out computations with Gaussian distributions?
  Q: How to generate random variables from Gaussian distributions using Cholesky factorizations.

- Topic 11 (gradient descent).
  Q: How does the basic gradient descent algorithm work?
  Q: What is a demonstration of simple examples where the algorithm performs badly?
  Q: What modifcations exist and how do they work?

- Topic 12 (PCA).
  Q: How does PCA work?
  Q: What are some applications of PCA and how do they work?

The [DSUC] page contains links to material for each of the topics.